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Experimentelle Untersuchungen über die Helligkeit der Farben.
 EDUARD GRUBER. Wundt's Philos. Studien., IX. 1893, 429-446.

The method used by Gruber for determining the relative brightness of colors was the natural one of direct comparison, applied, however, in the form of the method of minimal change. Two color-tops, one carrying a gray disk, *i. e.*, a black and white one (*A*), and the other a colored disk (*B*), were set up before a dark background. The gray disk (*A*) was at first set decidedly too dark and gradually brightened till it seemed to the observer of equal brightness with the colored disk (*B*). The condition of *A* was noted and then made much too light and gradually darkened till a match was again reached. The average of the two determinations, repeated several times on each side, gave the brightness of the color. The experiments made in this way, after a little practice, yielded excellent results, except in a few cases where the observers seem to have become habituated to a particular intensity of gray and to have judged by its return rather than by an unbiased comparison. For the special precautions employed the original must be consulted.

The author also investigated the Purkinje phenomenon and the effect of changes in saturation on brightness. The experiments on the first, so far as they went, gave results in accord with the similar experiments of Hillebrand. With decreased illumination, the blue and green not only lost less in brightness, as compared with the red and yellow, but less even than the neutral gray. The effect of change in saturation was tested by replacing a portion of the color on *A* by an equally luminous gray, but no change in the total brightness was to be observed. Experiments on a color-blind observer (red-green blind), made in the hope of deciding whether green appeared to him relatively brighter than it did to an observer with a normal eye, which might be expected on Hering's theory, unfortunately had to be discontinued before clear indications appeared. It is, perhaps, only fair to add that the same method of measuring the brightness of colors was used by Rood more than fifteen years ago; see *American Journal of Science*, Ser. 3, XV. 1878, 81-82.
 E. C. S.

On a Color System. O. N ROOD. *American Journal of Science*, Ser. 3, XLIV. 1892, 263-270.

In this article Professor Rood describes a method of working out a reproducible color system with the color-top, provided that there is at hand a single disk of known hue and power of saturation, *i. e.*, efficiency in the formation of gray when mixed with its complement. By combination with the standard disk, the power of saturation of its complement and of colors differing but slightly from that, are determined, and from these in turn the powers of saturation of other disks, till a considerable range in the color scale has thus been measured. When three colors widely enough separated to form the corners of a color triangle have been reached, such a triangle may be constructed in the usual way from the equation giving their mixture for gray, taking into account also their power of saturation, as already determined. This forms the basis of the system and other colors are assigned places in it in the usual way. For the details of the method and the discussion of the nature of the system thus constructed, the reader is referred to the original. The author unfortunately does not specify how the *hues* to be placed at the corners of this color triangle are to be selected, whether by reference to the spectrum, to well-known pigments, or in some other way—an omission that would have to be supplied before any-

one could exactly reproduce the color triangle described, though the author's generous offer of samples of colored paper with coefficients of saturation determined, might for the present supply this defect.

E. C. S.

Eine neue Theorie der Lichtempfindungen. CHRISTINE LADD FRANKLIN. *Zeitschrift für Psychologie*, IV. 1892, 211-221. This paper is a full statement of matter presented in abstract at the International Congress of Experimental Psychology in London, 1892. The author's abstract will be found in the Proceedings of the Congress, pages 103-108, also in the *Johns Hopkins University Circulars*, June, 1893, and in *Science*, July 14, 1893.

On Theories of Light Sensation. CHRISTINE LADD FRANKLIN. *Mind*, Ser. 2, II. 1893, 473-489.

To propose a new theory for matters so long and carefully studied as those of physiological optics is a considerable feat, but one that Mrs. Franklin has accomplished with such success as to receive friendly notice in the address of the president of the British Association (*Nature*, Sept. 14, 1893, p. 469). The author's own abstracts are so accessible that no summary of her theory need be given here. Suffice it to say that, like all the better modern theories, it has been given a photochemical form. Two visual substances are assumed in the retina, one whose decomposition yields the stimulus for white (sensations of the black-gray-white series) and another whose decomposition is different for different kinds of light, giving by partial decomposition the stimuli for red, green and blue, and by complete decomposition the same decomposition-product as the first visual substance, and thus also the white sensation. How the theory fits with various classes of facts is set forth in the original, together with the chief difficulties in the current theories of Helmholtz and Hering. The theory most resembling this of Mrs. Franklin's is that of Donders, by whose this was in a measure suggested. Completeness is too much to expect in an account that the author herself regards as tentative, and some gaps may have been purposely left to be filled hereafter. Something certainly should be said with reference to black, and the explanation of simultaneous contrast will need radical revision.¹ A great advantage of the theory is that it makes the phenomenon of complementary colors a matter of retinal chemistry, instead of a matter of mingled sensations or of opposing anabolic and katabolic processes. Its assumption of three primary colors enables it also to avoid the difficulties that color-blindness offers to four-color theories.

E. C. S.

Grundzüge der Physiologischen Psychologie. WILHELM WUNDT. Vierte umgearbeitete Auflage. Engelmann, Leipzig, 1893. Two vols., pp. xvi. 600, and xii. 684.

In this fourth edition, Wundt's standard work has received a general revision and an increase of nearly 180 pages, of which two-thirds is in the second volume. The main changes specified by the author, aside from such as were needed to bring the work abreast of present information, have been in the way of greater explicitness in the description of psycho-physiological methods and apparatus, and many new cuts of apparatus have been added. These changes will make the work more necessary than ever to the many laboratories now getting under way. The value and convenience of the

¹The reviewer understands that this matter has already received the author's attention.